

BIOGAS PROJECTS – A HOLISTIC APPROACH FOR PROJECT MANAGEMENT

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Abstract: The transformation of central energy production from fossil or nuclear sources into a de-central system of energy production from renewable sources is one of the major challenges of the next decades [5][6]. Green and renewable energies have major impact on the technological, ecological, business and social environment. Especially biogas projects are heavily disputed with respect to all four aspects. A sustainable energy production project based on biogas has to address all four aspects to be successful. A project management focusing only on the technical or the business side is likely to create no success [8][9]. Therefore, project management has to provide a comprehensive approach and it has to synchronize the progress in all four aspects of the biogas project [1][7]. This can be achieved by understanding the underlying characteristics of the project and the relevant stakeholders. Based on an analysis of these characteristics recommendations for a holistic project management are derived and discussed. The research is based on a case study in Germany.

1. Introduction

Today, projects do not necessarily fail due to technical issues. Especially projects with very diverse effects on their environment fail often due to a lack of ecological or business sustainability or because of resistance from major stakeholders [7]. Project management sometimes does not consider these aspects because project managers tend to manage the things happening inside their projects rather than the things happening outside their projects [1]. They focus on the execution of the (technical) work packages leading to the result of the project. For renewable energy projects the focus quite often is the construction and operation of the technical power generation machinery. Such a limited view on the project carries major risk for the success. A renewable energy project is always at the same time a technical/ecological project, a business development project and a change project within the relevant socio-ecological system.

2. Biogas Projects

Biogas projects have a quite drastic impact on the surrounding environment [4][7][10]. Compared to wind power or solar power projects they are rather big and have many connections into the socio-ecological system. Wind power and solar power plants are based on a big investment and rather low operating costs since wind and sun are for free. Biogas projects have an investment phase, too. But apart from this they have high ongoing operating costs. From business development point of view they are not a typical investment project but more like a small and midsize enterprise (SME). Biogas power plants need several thousand square meters of land for the power plant and several hundred hectares of land for growing crops and

distributing the biological waste. They need farmers as suppliers and staff for operations. In addition, they compete with local farmers for land and crops.

Therefore, biogas project management has to address the following issues:

- Planning faces a high level of uncertainty since the technology is rather new and still developing fast.
- The regulatory framework is complex since it is combining law regulations from construction, agriculture, energy, environmental protection and health protection.
- The project is not finished with the construction but has to take at least 20 years (e.g. according german renewable energy sources act [11]) of operation and modification into consideration.
- Financing is not based on fixed asset financing but on project financing (cash flow based non-recourse financing).
- The project requires skills in business administration, technology, farming, finance and supply chain management.
- The project affects many stakeholders and changes the socio-economic environment in the respective region (esp. changing the distribution of economic power and resources between farmers)
- The project has an impact on the ecology in the region (changing the farming, e.g. towards maize as main crop)

To address all issues with the necessary tools and methods requires an elaborated project and risk management.

3. Case Study: Biogas Power Plant in North Rhine Westfalia, Germany

Many observations in this contribution are based on a real biogas project in Germany in the state of North Rhine Westfalia. Germany is one of the major biogas markets, in 2010 more than 85% of the biogas power plants based on agricultural crops and animal waste were run in Germany [13]. This is due to the german renewable energy source act (EEG [11]) which guaranties a 20 years purchase contract for all electricity produced by an operator of a biogas power plant. Prices are fixed for 20 years, too. The electricity is purchased by the local grid operator and the cost is distributed to all electricity consumers.

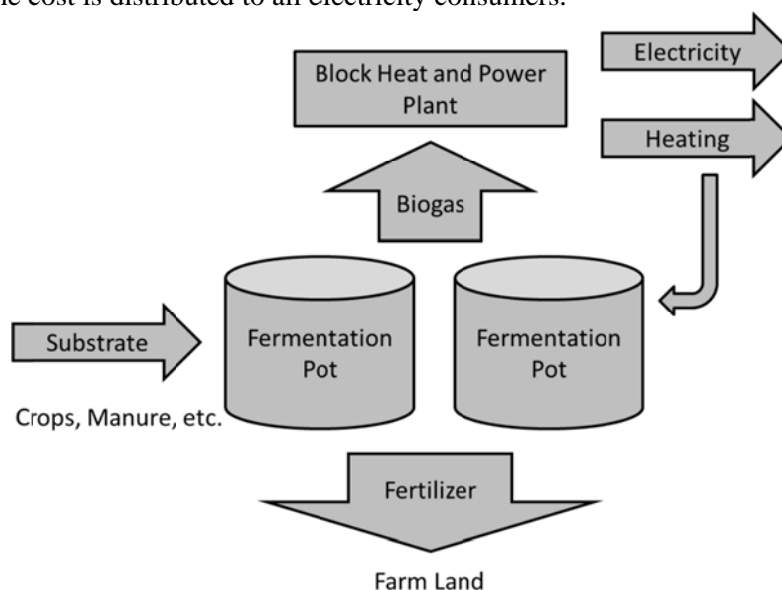


Fig. 1: System View of a Biogas Power Plant based on Agricultural Products

Due to this pretty simple system of subsidizing biogas power plants, more than 7000 biogas power plants were built in Germany until 2012. These biogas power plants are mainly based on a very similar concept. They have medium size (around 400 kW electrical power), a similar annual revenue (between 500 kEUR and 1 Million EUR) and are fed with biomass from agriculture and farming. The biomass is processed in fermentation pots and produces biogas (approximately 50-60% methane) and liquid fertilizer. A block heat and power plant uses the biogas to produce heat and electrical power.

In the case study, a biogas power plant with two heat and power plants (340 kW and 250 kW), 2 fermentation pots (4500 cbm total fermentation volume) and storage silos for 10000 t of crops and 4500 cbm of fertilizer was built. The construction was done in two phases. Phase 1 from August 2009 - May 2010 was doing the construction of the 340 kW power unit, the silos and the fermentation pots. Phase 2 from September 2011 – May 2012 was adding the 250 kW power unit and the fertilizer storage. The total investment of phase 1 was 1.4 Mio EUR, the phase 2 investment was 1 Mio EUR. The project was financed by raising investment money and by long term bank loans. A 20 years contract with the local grid operator guarantees the revenue.

The project was facing several severe issues:

- The first planning was done in 2007 and the investing company applied for a public permit for the construction and operation in early 2008. The aim was to produce the first electricity by the end of 2008. This was due to the fact, that the German renewable energy source act was changed at beginning of 2009 reducing the financial parameters for the electricity price. The law has a clause guaranteeing the 2008 prices to every power plant that starts electricity production in 2008. This was not achieved. The public permit was not granted until August 2009. The reason was a big resistance of local farmers against the power plant. Due to their influence on the local city government, the permit was blocked as long as possible. This permit was granted after many negotiations on county level. The conflict with the farmers and the local city government was not solved before 2011 and is still a risk for the project.
- Due to changes in the biogas technology the initial planning was changed in 2009. Following to the late permit and the changes, the construction phase extended into winter. In Germany, winter 2009/2010 was the longest and coldest winter since 1947. This extended the construction phase until May 2010 and added technical problems to the whole system. The issues were only partly anticipated due to the novelty of the technical design. The delay added substantial financial stress to the company.
- Between phase 1 and phase 2 of the construction project, the biogas power plant was operated in an half-ready status. This caused technical issues and additional effort. Nevertheless, it made it easier to set up the necessary supply chains (e.g. for crops) and the learning curve for the operation was less risky.
- For phase 2 the schedule was substantially tightened due to an unexpected change in the German renewable energy source act in January 2012. This change with a drastic decrease in electricity price was announced in spring 2011. Therefore, the target for phase 2 was to get the 250 kW power unit up and running until end of 2011 (to secure the price level of the old law). This was achieved in December 2011. Nevertheless, construction continued until May 2012. Meanwhile, the conflict with the local farmers was reduced by winning them as suppliers (crops) for the biogas project. The situation with the local city government was relaxed by initiating a green energy heating project for a local housing community.

The project was continuously documented with monthly plan updates, financial figures for both the investment and the operation (P&L sheet) and business plans. All technical data of the operation was recorded (it is anyway needed for government reporting).

4. Synchronize Technical Development, Business Development and Change

A successful biogas project has to cover the whole life cycle of the project. It is not enough to consider only the construction project or the first year of operation. The project has to be run as a consecutive or parallel execution of planning, construction and operation phases. The planning phases have to consider the complex regulatory environment. In Germany, this is given by the renewable energy source act (EEG [11]), the regulatory environment of the energy sector (both national and EU level [13]) and the regulatory environment for agriculture (mainly EU level). Meaning, it combines some of the most complex parts of legislation. The construction phase has to consider the fact, that the biogas technology is quite new and not yet mature. The operation phase has to deal with technical and agricultural challenges. During all three phases, at the same time and in parallel the inherent technical project, the business development project and the change management project is ongoing. A holistic project management is balancing the needs of all three phases and all three project types. The project manager is using tools from all three project phases and project types and connects them.

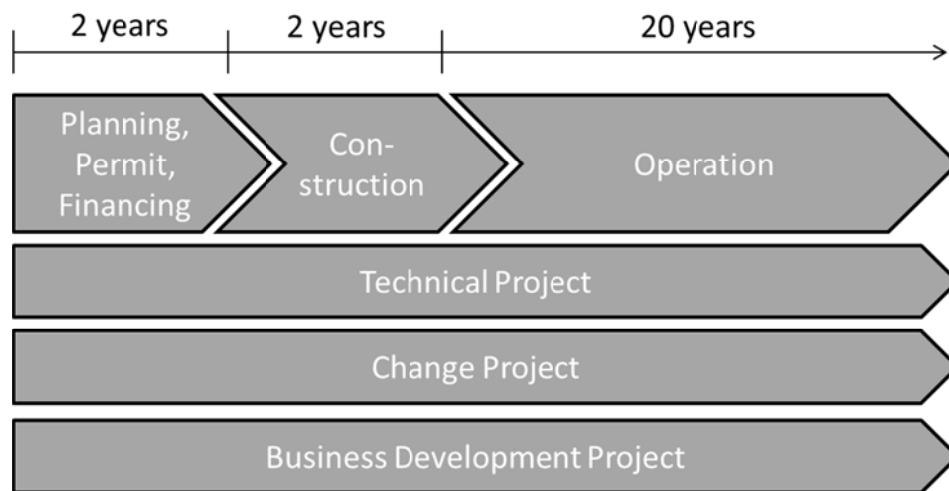


Fig. 2: Phases and Aspects of a Biogas Project

In the planning phase, it is required to synchronize the technical planning decisions and the business plan updates. This process involves a learning curve. Unfortunately, both parts are highly dependent on the regulatory framework, especially on the renewable energy source act and the dates for the change of this law. This affects the communication with the bank for securing the long term loans. In general, a bank needs at least 2-3 month of a stable business case to come to a financing decision. This “window of opportunity” has to be managed carefully. In addition, a communication process with the other stakeholders has to be started. It is necessary to win supporters with high reputation within the local community [7]. Nevertheless, the stakeholder management is difficult since business changes or regulatory restrictions can still change the whole project quite drastically.

The construction phase is usually under high time pressure since the deadlines for the changes of the regulatory framework (again mainly the renewable energy source act) have to be met. If the electricity production cannot be started before the deadline, the whole project is usually dead, too. The recent changes in the renewable energy source act in Germany (2004, 2009, 2012) had major impact on biogas technology and the respective business cases. In the construction phase, a close interaction with the public bodies is mandatory. The stakeholders from the public bodies are more or less project members in this phase. Since biogas technology is changing fast, adaptations of the technology during the construction phase as well as changes

to the regulations (e.g. environmental protection) are quite normal and have to be implemented. This is only possible, if public bodies take pragmatic decisions. In this phase, construction companies, public bodies and banks are the main stakeholders.

In the operation phase, the project turns into a small and mid-size enterprise (SME) running a predominantly agricultural business. The operation is driven by phases of harvest and phases of fertilizing the land (an average biogas power plant needs around 15000 t of input per year and produces around 13000 t of fertilizer). One focus is the management of the respective supply chains and the maintenance activities. During the operation phase, the project changes the socio-economic environment. Usually, the region turns from an energy importer into an energy exporter. This results in a financial flow into the region and into the system of farmers and technical maintenance companies. The farmers owning the power plant may purchase additional land, they are gaining economic power. The ecology of the region is changed due to new crops and new forms of farming. Therefore, stakeholder management is necessary to keep a reasonable level of acceptance for the project.

Risk Management is mandatory during all phases of the projects. In connection with an ongoing sensitivity analysis of the business case and a careful stakeholder analysis, the risk management is a continuous source of mitigation actions. A good tool for assessing the risks and deriving respective action is the failure mode and effects analysis (FMEA) [12].

5. Results and Conclusion

The execution of the biogas project described in the case study contributed to the development and the assessment of the methodology. Today, the biogas power plant is in full operation. The lessons learned for the project led to the emphasis on the 3-projects-in-1 view on biogas projects. A key to make such a project successful is the parallel execution of a technical project, a business development project and a change project. If all three views on the biogas project are considered in a balanced way, the issues can be identified and addressed early. In the case study, the first two years of the project were suffering from an underestimation of the change aspect. This led to a 1.5 years delay of the public permit and put major stress on the overall project. Addressing the change of the socio-economic system by setting up the green energy heating project for the local housing community and by purchasing crops from more local farmers helped to solve the issues.

On the other hand, especially the business development project was addressed with high effort from the start of the project onwards. A good modeling of the business case allowed early sensitivity analysis. This helped to convince the banks and to secure financing. While going through the learning curve, a good prediction of investment cost and profit&loss was possible. This was needed when the project experienced financial stress due to the missing public permit.

There is a lot of demand for future research. Biogas projects in Germany were mainly started between 2006 and 2011. They are all in a similar phase and they still have to be operated for at least another 15 years. Due to the fixed electricity price and the (consequently) fixed revenue, the projects have to find ways to cope with the rising cost curve. Since the cost curve will possibly cross the revenue curve in the second half of the project, issues have to be expected especially in the late years of operation. Solutions for this problem still have to be found.

Meanwhile, biogas projects in Germany are nearly impossible due to the recent renewable energy source act 2012, due to limitations in the availability of farm land and due to growing resistance in the German population against all kinds of energy projects. Nevertheless, biogas can still play a major role in the German green energy agenda since the energy (gas) can be stored. Furthermore, a major demand from other countries is expected. Especially, emerging

economies can benefit from this kind of renewable, de-central and demand driven type of electricity and heat production.

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